

EXECUTIVE SUMMARY

CECA believes that distributed energy, defined as electric power generation that is located on or near the energy consumer's site, when properly integrated with an improved national electric power system, incorporated into the economic structure, and accommodated by appropriate regulatory and administrative regimes, has the potential to benefit consumers significantly by leading to:

- Lower cost electricity and higher net energy efficiency;
- Enhanced end-user energy source and design choices;
- Improved overall system reliability;
- Enhanced environmental quality;
- Cost-effective peak load accommodation strategies;
- Improved power quality and reliability for specific end-user needs, particularly in the digital economy; and
- A new platform for integrated consumer services involving the convergence of electricity, natural gas, and telecommunications grids.

These benefits may be realized while simultaneously advancing a number of public goods, such as lessening the environmental impact of energy production and use, permitting flexible strategies to meet anticipated significant increases in demand, promoting equity for consumers, and ensuring market access for new supplies.

As an organization dedicated to identifying and promoting policy initiatives that benefit consumers, CECA convened the Distributed Energy Domestic Policy Forum as a meeting place for diverse views of state and federal government, industry, utilities, non-governmental organizations, consumers, and environmentalists. The goal was a thorough discussion of the many technological, regulatory and business issues that must be addressed to effect the major change implied by large-scale deployment of distributed energy resources, referred to throughout the report simply as DE. As an outcome of these discussions, CECA is convinced that many, if not all, of the benefits described above can be realized in the years ahead through coordinated government, private sector, and utility action.

In reaching this conclusion, CECA also recognizes the significant challenges and concerns that must be addressed if the potential of DE is to be fully realized. Some expressed reservations about the significance of DE in the national energy infrastructure and cautioned that if DE was not appropriately utilized the intended benefits would not be realized. Addressing these concerns is central to developing a successful strategy for distributed energy. The confluence of technology development, electricity sector restructuring, and evident need for relieving supply and transmission constraints provides an exceptional opportunity over the next few years to focus on and work towards a 21st Century power

infrastructure. CECA believes that the time has come for a concerted effort to move toward greater reliance on DE to meet our burgeoning energy needs.

The United States, like other advanced nations, is increasingly dependent on electricity. Electricity as a fraction of total energy use has grown from 25 percent in 1970 to nearly 40 percent today. Its use continues to grow by about two percent per year, meaning that about 150GW of new capacity will be needed over this decade. The importance of an adequate supply of electricity to the United States, and indeed to modern civilization, cannot be overstated. Electrification received top billing when the National Academy of Engineering ranked the most important engineering achievements of the last century – a remarkable acknowledgement of the importance of electricity to society in an era that witnessed extraordinary developments in medicine, nuclear technology, communications, transportation, industrial productivity, space travel and computers.

The achievements of the 20th Century, however, remarkable as they are, do not assure that we are prepared for the challenges of the 21st Century. Indeed, the nation's existing electricity transmission infrastructure is generally acknowledged to require substantial upgrade to meet rising demand and to decrease vulnerability to natural or intentional disruption. The economic dislocations caused throughout the country by summer outages of 1999 and 2000 emphasize the importance of this issue, as do the recent sobering consequences of the generation and transmission constraints in California.

In addition, the extraordinary demands for high reliability and quality of power presented by a segment of the “new Internet economy” are quite clearly beyond the reach of the traditional power system architecture. Customers with particularly sensitive loads have already adopted redundant electric power system designs including battery uninterruptible supplies and redundant standby generation. This is an existing market for DE that is expanding as data centers and Internet web hosting facilities expand and increase in number. DE resources can further help address supply and transmission constraints but, in some respects, DE is incompatible with the current design of the energy infrastructure. Transmission and distribution facilities were built as components of a vertically integrated infrastructure designed to support the flow of electricity in only one direction – from central generation plants to customer meters. In the new open market structure, transmission facilities are being used to support a more horizontal flow of electricity from multiple generation sources to multiple buyers (making use of a transmission infrastructure that was largely designed for only limited interregional power flows). Because DE resources introduce generation supply at new points in the grid, often in the downstream distribution network, three categories of potential problems in the existing energy infrastructure may need to be addressed:

First, the existing transmission facilities are clearly constrained in their ability to support an open market structure in many parts of the country as it was designed for different purposes. Consequently, there are many new congested transmission facilities that create market power opportunities. This issue will not be quickly resolved because new transmission facilities require long lead times, encounter increasingly difficult siting questions, and are expensive to build. Further, the current state and federal regulation of transmission provides little incentive for the construction of new facilities. Ownership and control issues further exacerbate the

problem. As an alternative to expansion of the transmission system, locating generation close to the load is a simple option. This applies to both distributed energy and central station generation. Successful and broad deployment of DE will require efforts to bring down the costs of DE technologies themselves as well as to improve and lower the costs of the “helping technologies.”

Second, today’s distribution grids will not support the necessary transaction management, the capacity requirements, or system protection and control when there are significant levels of two-way power flows. To effectively manage a grid in which significant electricity is generated at the ends, investments will need to be made in physical changes to the system and information from more disparate sources must flow to and be processed by the grid manager. At the same time, DE installed within the distribution system may defer the need for facility upgrades to meet growing demand. Consequently, DE can both impose costs and create savings in the power delivery infrastructure. Current rate design is inadequate to address these issues.

Third, if DE becomes a truly major marketplace success, DE resources installed on customer sites to handle loads formerly supported by the distribution grid may, in effect, leave the distribution assets installed to support that load “stranded in place,” with no throughput revenue to amortize the capital costs. The lost throughput revenues represent a potential economic loss to the distribution grid utility that must be absorbed elsewhere, either by other customers still on the grid or by the utilities’ owners.

DE requires a more flexible grid in which flows can move in many directions, horizontally as well as vertically. To accommodate these flows, the grid will require additional throughput capacity, physical redesign, and more comprehensive intelligence throughout. Ultimately, this intelligence will be manifested in the form of a real time, two-way communications capability with comprehensive monitoring and control.

An expanded role for DE resources will require a new design and management approach toward traditional transmission and distribution facilities. The transition will be complex and will take extended time to implement. Thus, it is essential to develop a blueprint for change now that will go well beyond transmission and distribution (T&D) considerations. For example, significant expansion of DE would likely place significant demands on the natural gas infrastructure, one that is already straining under increased demand. An innovative solution is critical to this challenge.

The supply and transmission constraints are real, and they will not be resolved simply, quickly or inexpensively. If DE resources are to achieve their potential in reducing or resolving those constraints, time is of the essence.

I. FINDINGS

The CECA Distributed Energy Forum engaged in extensive investigations of the current and future prospects for distributed energy resources. Briefings and presentations were presented

in plenary meetings of the Forum and in numerous meetings of subcommittees. Discussions of the Forum led CECA to develop a set of general findings that represent the highlights and results of these inquiries.

1. General

- Distributed energy is neither a new concept nor a new technology; rather it is a concept and family of technologies that are coming of age as technological advances, and improvements in communications provide the opportunity for the value of DE to be more fully realized.
- The CECA DE Forum identified significant use of conventional technology in DE applications, standby power, cogeneration and self-generation. Standby power systems have been used for many years to provide end users with higher reliability for critical facilities that demand redundancy in electric power supply. This distributed energy application has become even more important in the face of the current crisis in electric reliability in California and other parts of the country.
- Pacing constraints that limit DE fall into four categories: (1) the current state of DE technologies limits their practical usefulness in some applications; (2) DE economics are case-specific and are more compelling in some cases than others; (3) limited availability of good information about the costs and performance of DE and stakeholder inexperience with new DE technologies and applications slows growth of DE markets; and (4) existing industry regulation and utility business practices create structural barriers to DE resource use in some cases.
- Current DE cost/performance is limited by the high capital cost of most DE systems. However, research, development, and demonstration (RD&D) investments in promising DE technologies will reduce costs and improve performance over time. Indeed, continued RD&D investment in DE technologies, focusing on improved fuel efficiencies, decreased emissions levels, and design standardization, is a critical priority.
- Ultimately RD&D is expected to change the finding on economics. Successful developments that lower costs will lead to wider utilization of DE. These changes will most likely take place first in (1) new standby DE facilities that address reliability and price volatility and (2) commercial and industrial applications where DE is installed to meet year-round thermal loads and where electricity generation is an adjunct to heating needs. A major driver of RD&D for DE stems from the search for high performance and low cost fuel cells for vehicle power. This injection of significant RD&D resources may lead to a major improvement for the stationary DE applications.
- For individual consumer DE applications, the economics can be improved dramatically if other benefits have high value (such as combined heat and power, reliability and power quality, power sales to the grid, new services available by the convergence of electricity and telecommunications) or if mechanisms exist to share utility savings that can be

achieved in some cases (such as transmission/distribution investment deferral and grid support).

2. Technology and Applications

- The current state and cost of DE technology generally limits its practical utility to larger commercial, industrial and institutional customers. Several technology hybrids are currently being investigated that, with further development and testing, could significantly expand the utility of DE. Finally, because both the DE concept and some of the technologies are relatively new to customers, the end-user markets remain largely uninformed about their practicality and application potential.
- DE technologies such as microturbines and renewables have progressed considerably down the cost curve over the last decade to the point that a substantial number of applications have been realized. Although there are still significant technical hurdles, the prospects for further technological innovation are excellent. One example is a potential revolution in affordable small-scale automotive fuel cells that could soon reduce the cost premium sufficiently to spur considerable use even for individual consumer DE applications.
- Developing DE technologies could be well suited to play a significant role in the future energy infrastructure. How large a role DE may actually play is not yet clear and the outcome depends, in large part, on how technology developments, manufacturing costs, fuel costs, financial incentives, and regulatory decisions affect the economics. In the absence of integrated technology, financial, environmental, and regulatory policies – as well as further cost reductions – DE will face difficulty in complementing more conventional alternatives (investment in traditional generation, transmission and distribution) in addressing capacity and reliability.
- Clear opportunities are apparent for baseload DE applications in the range of ~1MW and above, utilizing primarily combustion turbine units. Cogeneration installations will reduce the total energy costs, enhancing these opportunities. Peak shaving opportunities utilizing internal combustion (IC) engines in this scale range are also apparent. The use of standby power generation for meeting extreme price “spikes” is a new application that has more fully emerged in the last year. This new application may operate 50 to 200 hours a year and is an alternative method to curtail demand from the grid. Unlike conventional demand curtailment programs, DE, in this context, reduces the demands on the grid without curtailing the supply of electricity to the consumer. These opportunities are economically attractive even without assuming cogeneration.
- Combined heat and power applications (CHP) are an important feature of DE. Many CHP applications in industry are fully developed, especially in the chemical, petrochemical and pulp and paper industries. New applications are certain to emerge as new, smaller scale CHP systems become practical.

- Microturbine efficiencies have not yet met early expectations. Combustion efficiencies in the high 30 percent range were initially forecast, but recent field trials among all three microturbine developers are achieving only mid-20s (with no cogeneration applications). When used to supply a viable thermal load that is independent of season, the economics for microturbines will be more attractive. The number of such applications appears limited at the thermal ratings of the current emerging commercial units. However, the emergence of the technology into the market may lead to more innovative applications, and further RD&D could significantly raise microturbine efficiency.
- Invented in the mid-1800s, fuel cells today continue to promise significant efficiency gains over heat engines – gasoline, diesel or combustion turbines. The critical challenge for fuel cell technology lies in capital cost and life of the complex chemical and electrochemical components that make up this conceptually simple electrochemical device. There is a significant worldwide effort to develop fuel cells for mobile and stationary applications. If such efforts reach their technical and cost objectives, then fuel cells may have a major impact on stationary electric power generation and may revolutionize the very concept of the electric grid. As discussed below, considerations of fuel supply and fuel cost will then be a significant issue.

3. Infrastructure

- DE is another tool for improving system performance and customer reliability and increasing energy and system efficiencies. Properly located and operated, DE can defer or eliminate traditional distribution system investments and provide distributed ancillary services within a modern power grid.
- The wide range of estimates of system benefits examined and presented during the course of the CECA DE Forum underscores the uncertainties and inconsistencies in the data on transmission and distribution system benefits. The same is true of environmental benefits and the value of environmental externality mitigation that might be associated with DE (such as the land impacts of mining, drilling, and transporting of fuels). Other possible externalities associated with distributed generating technologies include air, water, and solid waste emissions, land-use issues, and regulatory and permitting costs. Local zoning and ordinances that restrict noise and emissions may also be critical. How such externalities are reflected in power sector statutory and regulatory constraints, and how their mitigation is translated into economic benefit, are significant issues.
- The optimal resolution of particular power quality and reliability requirements tend to be situation-specific, and solutions can often be engineered that do not require major capital outlays. Most power quality problems can be resolved cost effectively through the application of control and conditioning solutions, rather than through isolation from the commercial grid. Many power quality problems originate on the customer side of the meter, and thus cannot be resolved through isolation from the grid.

- If widespread and significant use is made of natural gas fueled DE, gas distribution utilities will need to make investments in upgrading the throughput capacity of local distribution pipes. Extension pipes to individual end user premises where DE resources are installed may need to be replaced with larger ones. Of greater consequence will be the impact on main trunk networks and pumping stations. Maintaining system-wide gas pressure at acceptable levels while accommodating the throughput demands of individual DE sites may require large-scale capital projects.
- Deploying significant DE installations in the nation’s energy infrastructure raises the prospect of major structural shifts in fuel consumption patterns. As end user loads are shifted from central electric generation facilities to decentralized natural gas fueled facilities, strains may be experienced in both local electric distribution facilities and local gas distribution facilities. For the longer term, significant use of renewable technologies would relieve fuel supply challenges.

4. Policy and Regulatory

- Existing electric utility pricing and rate structures do not provide accurate and timely price signals to customers about the costs of electricity under differing demand and supply conditions. Economic incentives for customers to modify their demand or invest in DE would be enhanced by accurate price signals. Incentives to improve DE will also be enhanced by the development of a market for DE. Implementing time of day rates and more sophisticated metering is one option. Development of “reserve markets” and other incentives for installation of DE is another. Overall, the issue of the design of rates and tariffs that acknowledge the potential of DE needs considerably more attention.
- Current electric utility pricing and rate structures do not facilitate the recognition and valuation of system benefits from DE installations, and do not provide for crediting that value to DE owners and operators. In the absence of realized systems benefits, the opportunities for DE will be narrowed. Also, some review and approval processes and interface requirements may need to be improved so that they do not impede the development of new DE projects.
- Environmental emissions levels of many current DE technologies raise important societal issues. The most widely used DE systems are internal combustion engines, most of which use diesel fuel. Expanded use of these systems could exacerbate air quality problems in many localities, depending on the fuel, the vintage of the equipment, and presence of emission control systems. Development and production of low sulfur diesel fuel could lessen this problem. Evaluation of the net effect of DE utilization on overall emissions is dependent on the determination of which central generation resources they are augmenting or replacing. CHP applications can increase net energy efficiency over conventional generation installations, with a concomitant overall reduction in emissions, albeit with possibly increased emissions close to the end user. The shift from emissions at remote locations to emissions near the consumer shifts the exposure patterns to air emissions and is not a subject that has been extensively investigated. In addition, although customers

have shown significant interest in the use of DE technologies using renewable energy sources, the proliferation of these technologies is still limited by their costs and by intermittent availability.

II. CONCLUSIONS

From the findings of the CECA DE Forum, CECA has inferred a number of general conclusions. These conclusions result from reasoned judgment applied to the findings and are a consequence of these findings.

1. General

- CECA believes that a robust energy infrastructure and additional energy resources are a national priority. This is a widely held view, reinforced by recent highly publicized events that have focused the public's attention on energy.
- CECA's conclusion is that, despite the many technological, economic and structural obstacles that must be addressed, DE does today and should continue to make an expanded contribution to meeting the public's growing and diversifying needs for electricity, and that an expanded role for DE will yield benefits of economy and quality. Technological progress in DE is not enough – it is DE progress relative to central station technology and power delivery infrastructure that will make DE more competitive and attractive to customers and utilities alike.
- CECA contends that current thinking about the evolution of the nation's electric power grid needs to be broadened to include a realistic appraisal of the capabilities of DE. DE should not be viewed as a replacement for conventional electric infrastructure; rather, it should be seen as a critical supplement that can optimize the overall system and support introduction of new consumer services.
- Having reviewed the consumer economics of DE, CECA concludes that availability of third party DE providers would facilitate the development of these resources. Third parties can specialize in installation, operation and maintenance, aggregate consumer demand, and negotiate with host utilities. Development of such a sector would not be unusual. In fact, an infrastructure of sales, service and support has been developed to help move consumer durables into mass-market commodities.
- The experiential base of DE activity provides the platform for change. CECA views DE resources as potentially well-suited to play a significant part in the response to the shortfall of resources brought about by supply constraints, environmental regulations, and increasing demand, as well as to enhance the reliability, quality and cost effectiveness of electricity for consumers. DE installations can deliver new generation capacity without consuming transmission resources that are currently in short supply and likely to remain so in the future. When configured properly and deployed in appropriately targeted

applications, DE can increase overall fuel use efficiency and augment grid reliability and quality for customers with more demanding energy requirements.

2. Technology and Applications

- Several interesting and potentially very valuable evolutionary improvements in DE technologies are on the horizon that should enhance the economic attractiveness of DE resources in the near future. In this context, DE should be viewed as an important supplement to central station power generation. However, it is possible that onsite generation innovations could develop into a “disruptive” technology, undermining, if not replacing, grid functions. Careful consideration needs to be given to this possibility.
- Current electricity pricing, rate structures and tariffs do not adequately assist end users to make economic decisions about DE since variations in the commodity (kWh) price or differentiated locational costs of the infrastructure are not reflected in the rates. Furthermore, a larger portion of the fixed costs of the utility’s delivery network is priced on a per kWh basis, overstating the cost of energy. In many situations consumers are faced with exit and/or standby tariffs that mitigate the potential economic benefits of DE investments. However, it is also important to note that there is generally no reasonable way today to allocate either the locational costs of capital infrastructure or the temporal variations in energy costs (except through time-of-day metering). New approaches to rate making will be needed to provide the necessary price signals to customers. Exceptions to this occur in the large industrial and commercial sector where specific contracts can be negotiated, time-of-day and demand rates can be utilized, direct links to energy control centers have been piloted, and sophisticated energy management systems can be used.
- For individual consumers or small businesses, utility-imposed practices and processes more appropriate to large users sometimes render DE projects uneconomic. Technology standardization that addresses legitimate safety and reliability concerns of the utility can be important. An expanded experience base will do much to address such impediments to DE.
- Although demand-side management programs have become moribund in recent years, the ongoing development of demand-side management technologies has continued. Such technologies will emerge again as solutions to diverse electric power system problems and DE will become a demand-side vehicle.
- The updating and integration of traditional standby power systems into a network of rapid response DE systems has been proposed and may improve overall system reliability as a new and useful application of an old technology. This new application has emerged as a direct result of restructuring of the electric industry. Such an approach to system integration of standby power sources may prove useful in meeting changing reliability requirements and mitigating excess price volatility in new electricity markets. This application is so new that all of the ramifications are not yet understood. Unless the use of these facilities is considered *de minimus*, environmental regulations and local zoning will

restrict the fuels and hours of utilization. As the vast majority of these units are diesel fueled, development of cleaner diesel fuels and/or use of natural gas may be necessary to mitigate environmental effects.

3. Policy and Regulatory

- There are numerous regulatory barriers to DE – a “legacy” problem that deters the economic use of DE resources. Many regulations were developed at a time when DE was not a viable option. New policies enabling the deployment of DE need to be developed.
- New rates and metering technologies are needed to facilitate the market for DE. New approaches to utility rate design are needed to reflect accurately the different values and costs of unbundled electricity and delivery services. As stated above, current pricing in the electric utility industry does not provide the mechanisms for recognizing the potential value of systems benefits from DE resources and crediting that value to DE operators where they in fact occur.
- Better understanding of distributed energy resources economics, markets, policies and technologies are needed, as are public education and outreach efforts to inform stakeholders. Indeed, it needs to be recognized that there are no apparent publicly available and independent economic analyses that address all of the costs and benefits of DE. Consequently, the economics of DE, except for the most straightforward applications, is not well understood and many open questions remain. Reliable analyses must be produced and published.
- Reliability and safety are important factors to consider in designing and operating the electricity grid. Regulators should recognize legitimate reliability and safety concerns, but not allow the overstatement of these concerns to serve as a barrier to the use of DE.
- Better models need to be constructed to evaluate the impacts of DE systems on distribution systems. The government can play a catalytic role in developing, evaluating, monitoring and promoting pilot programs that explore innovative intelligent system configurations.

III. RECOMMENDATIONS

The decline in transmission and distribution investments in the 1990s has collided with the wholesale and retail restructuring of the electricity industry. The result is seen daily in press headlines. Distributed energy resources emerge as a family of technologies and applications that can work to fill the gap between the capabilities of the existing electric power infrastructure and the growing needs for electricity. The participants in the CECA DE Domestic Policy Forum debated the merits and challenges of distributed energy. While the debate is sure to continue, it is clear that DE is a current, albeit modest, element of the nation’s infrastructure and will grow in importance as new technologies and applications

emerge in response to the opportunities created by restructuring and technological innovation. To move public policy forward, CECA makes the following recommendations.

- **CECA recommends that efforts to accelerate applications of DE should be a near-term objective of policymakers.** In particular, electricity restructuring legislation should reflect the potential importance of DE to a 21st Century power infrastructure. There is an urgent need to expand resources available to meet the nation's need for electricity. There are some applications in which distributed energy is already quite attractive and there are readily identifiable technological developments that could significantly improve the attractiveness of distributed energy.
- **CECA recommends the rapid adoption of interconnection standards by local, state and federal authorities as soon as the development of national consensus technical standards is completed by the IEEE.** Consensus industry standards that recognize, to the greatest extent possible, the relevance of local conditions allow manufacturers to sell their products specified to the national standard in all fifty states. These will increase benefits from the cost savings of volume manufacturing while preserving safety and reliability. The completion of the standard is expected by the third quarter of 2001.
- **CECA recommends that local, state and federal regulatory authorities work to “fast track” the market niche for the use of existing and new standby and emergency power facilities.** A concerted effort to assess the potential of DE applications should be initiated immediately. The use of existing DE standby and emergency power facilities is an application that can be brought into play today and become a new customer response to the reliability concerns and price volatility that is being experienced as this report is being completed (second quarter of 2001).
- **CECA recommends that DE be supported in a way that will enhance environmental quality, and, specifically, that total system impact be considered in the policy framework for DE.** Local siting issues with regard to emissions, noise, aesthetics, and other factors may be dominant considerations for specific projects in sensitive locations (for example, areas of high population density and/or poor air quality), but as a rule the environmental impact should also be evaluated relative to that of displaced activities (for example transmission line construction, baseload plant requirements, heating and cooling systems, or greenhouse gas emissions). Similarly, the environmental impact of DE systems used for backup power or peak shaving, which today are predominantly internal combustion engines, needs to be evaluated, particularly in the context of local and regional regulation.
- **CECA recommends a concerted effort to develop and adopt best business practices in the treatment of DE.** Uniform and non-discriminatory business practices are essential to the success of DE in the marketplace. These practices should facilitate the technical and economic transactions between the host utility and the DE project developer. CECA recommends creating a working group of regulatory authorities, utilities, consumers, equipment manufacturers, and DE project developers to identify, develop and adopt best business practices.

- **CECA recommends that coordination and regulatory procedures be developed to facilitate and support the economic and technical transactions between the customer and the host utility.** In order for distributed energy to produce positive gains for one customer, without imposing negative impacts on the host utility or its other customers, the DE project must use an appropriate technology in an appropriate application. It must be implemented and operated in a sound manner and placed in a location on the grid where its services are needed and can either benefit the system or at least avoid increasing costs significantly for others.
- **CECA recommends that regulators and other stakeholders work to develop new and creative rate structures and business arrangements for DE.** Such arrangements should permit consumers, utilities, and other market participants to realize the potential economic, social and system benefits of DE while recognizing the potential costs as well. In designing new rate structures and business arrangements, individual characteristics of specific technologies, applications and distribution systems should be taken into account.
- **CECA recommends that local distribution utilities or service providers be allowed to own or operate DE, whether located on the grid or on customer premises.** Concerns have been raised about local utilities owning or operating DE resources. To address these concerns, CECA recommends that effective regulatory oversight be provided to safeguard against potential abuse of market power. With strong and effective oversight in place, CECA suggests that both distribution utilities and energy service providers be allowed to own and operate DE resources. As operators of the distribution component of the energy infrastructure, distribution companies are well positioned to identify and leverage DE resource opportunities at and below the substation level. Energy service providers are well positioned to develop DE projects and negotiate with the distribution utility or ISO for attractive rates or contractual payments for grid benefits that DE can provide.
- **CECA recommends a higher priority for Federal research, development and demonstration of distributed energy technologies.** The RD&D would: 1) accelerate cost reduction and performance improvements of distributed energy resources (principally gas-fueled and renewable technologies) to widen significantly the scope of economic applications; 2) stimulate the development of necessary enabling technologies such as basic work in advanced materials, fuel processing, combustion efficiency and simulation, sensors and controls, and power electronics; 3) address issues of systems reliability, architecture and integration; 4) continue development of analytic tools that identify the optimum applications for distributed energy much as it has done in support of efficient building design; and 5) apply sophisticated economic analysis to DE and place the results in the public domain. Much of this work will be carried out in partnership with industry. CECA recommends that the U.S. Department of Energy work with stakeholders to develop a ten-year roadmap for distributed energy RD&D.
- **CECA recommends a concerted effort to address the regulatory and institutional barriers to more widespread DE deployment.** States play a critical role in this issue. Uniform practices among the states are needed, to the extent practical, in order to realize economies of scale in the national deployment of DE resources. The Federal government

should play an important convening role, and CECA recommends that the Administration convene a working group representing all major stakeholders to “roadmap” a process for reducing or eliminating the institutional, business practice, and regulatory barriers while advancing safety and environmental values.

- **CECA recommends a national effort by all stakeholders to develop an action strategy to move forward from the current problems in restructuring.** With twenty states having moved forward with retail open access, more than half of the U.S. population has been exposed to greater risk of high prices for electricity and reduced reliability of electric supply. DE is one tool for incorporating customer response to market prices into the marketplace. Load management, efficiency and conservation are additional tools. It is essential that a customer response capability be developed if market forces are to work. This capability is largely absent in the diverse electricity markets. A concerted effort to address this problem with urgency is warranted.